

**CLAIMS**

We claim the following invention:

1. A grid that monitors a design simulation to support design verification coverage analysis, comprising:

a monitor declaration that provides a unique name for the grid;

n ordered axis declarations wherein n is at least 1, each said axis declaration names an axis comprising a first axis through a nth axis, wherein each said axis corresponds to a functional attribute of the design and has an axis size that comprises two or more functional states of said functional attribute and has a corresponding axis variable;

one or more logic expressions that evaluate whether the design has achieved one or more of said functional states, said logic expressions set each one of said n axis variables to an integer value corresponding to said functional state when said logic expressions evaluate true; and

a grid declaration that converts said n axis variables to a unique linear index value that corresponds to the cross-product of said functional states achieved by the design, said grid declaration also records a hit at said unique linear index value.

2. A system that monitors a design simulation using a grid to support design verification coverage analysis, comprising:

a monitor declaration that provides a unique name for the grid;

n ordered axis declarations wherein n is at least 1, each said axis declaration names an axis comprising a first axis through a nth axis, wherein each said axis corresponds to a functional attribute of the design and has an axis size that comprises

1 two or more functional states of said functional attribute and has a corresponding axis  
2 variable;

3 one or more logic expressions that evaluate whether the design has achieved  
4 one or more of said functional states, said logic expressions set each one of said n axis  
5 variables to an integer value corresponding to said functional state when said logic  
6 expressions evaluate true; and

7 a grid declaration that converts said n axis variables to a unique linear index  
8 value that corresponds to the cross-product of said functional states achieved by the  
9 design, said grid declaration also records a hit at said unique linear index value.

10 3. A method that makes a grid that monitors a design simulation to support design  
11 verification coverage analysis, comprising:

12 providing a monitor declaration that provides a unique name for the grid;

13 providing n ordered axis declarations wherein n is at least 1, each said axis  
14 declaration names an axis comprising a first axis through a nth axis, wherein each said  
15 axis corresponds to a functional attribute of the design and has an axis size that  
16 comprises two or more functional states of said functional attribute and has a  
17 corresponding axis variable;

18 providing one or more logic expressions that evaluate whether the design has  
19 achieved one or more of said functional states, said logic expressions set each one of  
20 said n axis variables to an integer value corresponding to said functional state when  
21 said logic expressions evaluate true; and

1 providing a grid declaration that converts said n axis variables to a unique linear  
2 index value that corresponds to the cross-product of said functional states achieved by  
3 the design, said grid declaration also records a hit at said unique linear index value.

4 4. A method that monitors a design simulation using a grid to support design  
5 verification coverage analysis, comprising:

6 declaring a monitor in a monitor declaration that provides a unique name for the  
7 grid;

8 declaring n ordered axes using axis declarations, wherein n is at least 1, each  
9 said axis declaration names an axis comprising a first axis through a nth axis, wherein  
10 each said axis corresponds to a functional attribute of the design and has an axis size  
11 that comprises two or more functional states of said functional attribute and has a  
12 corresponding axis variable;

13 evaluating one or more logic expressions to determine whether the design has  
14 achieved one or more of said functional states;

15 setting each one of said n axis variables to an integer value corresponding to  
16 said functional state when said logic expressions evaluate true; and

17 using a grid declaration to convert said n axis variables to a unique linear index  
18 value that corresponds to the cross-product of said functional states achieved by the  
19 design and to record a hit at said unique linear index value.

20 5. A program storage device readable by a machine, tangibly embodying a program  
21 of instructions executable by the machine to perform a method that monitors a design  
22 simulation using a grid to support design verification coverage analysis, comprising:

1 declaring a monitor in a monitor declaration that provides a unique name for the  
2 grid;

3 declaring  $n$  ordered axes using axis declarations, wherein  $n$  is at least 1, each  
4 said axis declaration names an axis comprising a first axis through a  $n$ th axis, wherein  
5 each said axis corresponds to a functional attribute of the design and has an axis size  
6 that comprises two or more functional states of said functional attribute and has a  
7 corresponding axis variable;

8 evaluating one or more logic expressions to determine whether the design has  
9 achieved one or more of said functional states;

10 setting each one of said  $n$  axis variables to an integer value corresponding to  
11 said functional state when said logic expressions evaluate true; and

12 using a grid declaration to convert said  $n$  axis variables to a unique linear index  
13 value that corresponds to the cross-product of said functional states achieved by the  
14 design and to record a hit at said unique linear index value.

15 6. A dependent claim according to Claim 1, 2, 3, 4 or 5 wherein said grid  
16 declaration maintains a map of hits at each linear index value determined during a  
17 simulation, and downloads said map to a database.

18 7. A dependent claim according to Claim 1, 2, 3, 4 or 5 wherein said unique linear  
19 index value is determined by multiplying the integer value of each said axis variable  
20 except the  $n$ th said axis variable by the product of the sizes of each higher-order axis  
21 than the axis to which said axis variable corresponds, summing the results, and adding  
22 the integer value of the  $n$ th said axis variable.

1 8. A dependent claim according to Claim 1, 2, 3, 4 or 5, wherein said monitor  
2 declaration, said axis declarations, said logic expressions, and said grid declaration are  
3 translated into a computer program comprising a higher-order software language using  
4 a parser.

5 9. A dependent claim according to Claim 8 wherein said parser further translates  
6 each said unique linear index value to a character string comprising a concatenation of  
7 character strings that correlate to said grid name and to each said functional state  
8 within said cross-product achieved by the design.

9 10. A grid that monitors a design simulation to support design verification coverage  
10 analysis, comprising:

11 a monitor declaration that provides a unique name for the grid;

12 n ordered axis declarations wherein n is at least 1, each said axis declaration  
13 names an axis comprising a first axis through a nth axis, wherein each said axis  
14 corresponds to a functional attribute of the design and has an axis size that comprises  
15 two or more functional states of said functional attribute and has a corresponding axis  
16 variable;

17 one or more logic expressions that evaluate whether the design has achieved  
18 one or more of said functional states, said logic expressions set each one of said n axis  
19 variables to an integer value corresponding to said functional state when said logic  
20 expressions evaluate true;

21 a grid declaration that converts said n axis variables to a unique linear index  
22 value that corresponds to the cross-product of said functional states achieved by the  
23 design by multiplying the integer value of each said axis variable except the nth said

1 axis variable by the product of the sizes of each higher-order axis than the axis to which  
2 said axis variable corresponds, summing the results, and adding the integer value of  
3 the nth said axis variable, said grid declaration also records a hit and maintains a map  
4 of hits at each linear index value determined during a simulation, and downloads said  
5 map to a database; and

6 a parser that translates said monitor declaration, said axis declarations, said  
7 logic expressions, and said grid declaration into a computer program comprising a  
8 higher-order software language, said parser further translates each said unique linear  
9 index value to a character string comprising a concatenation of character strings that  
10 correlate to said grid name and to each said functional state within said cross-product  
11 achieved by the design.

12  
13 11. A system that monitors a design simulation using a grid to support design  
14 verification coverage analysis, comprising:

15 a monitor declaration that provides a unique name for the grid;  
16 n ordered axis declarations wherein n is at least 1, each said axis declaration  
17 names an axis comprising a first axis through a nth axis, wherein each said axis  
18 corresponds to a functional attribute of the design and has an axis size that comprises  
19 two or more functional states of said functional attribute and has a corresponding axis  
20 variable;

21 one or more logic expressions that evaluate whether the design has achieved  
22 one or more of said functional states, said logic expressions set each one of said n axis

1 variables to an integer value corresponding to said functional state when said logic  
2 expressions evaluate true;

3 a grid declaration that converts said n axis variables to a unique linear index  
4 value that corresponds to the cross-product of said functional states achieved by the  
5 design by multiplying the integer value of each said axis variable except the nth said  
6 axis variable by the product of the sizes of each higher-order axis than the axis to which  
7 said axis variable corresponds, summing the results, and adding the integer value of  
8 the nth said axis variable, said grid declaration also records a hit and maintains a map  
9 of hits at each linear index value determined during a simulation, and downloads said  
10 map to a database; and

11 a parser that translates said monitor declaration, said axis declarations, said  
12 logic expressions, and said grid declaration into a computer program comprising a  
13 higher-order software language, said parser further translates each said unique linear  
14 index value to a character string comprising a concatenation of character strings that  
15 correlate to said grid name and to each said functional state within said cross-product  
16 achieved by the design.

17 12. A method that makes a grid that monitors a design simulation to support design  
18 verification coverage analysis, comprising:

19 providing a monitor declaration that provides a unique name for the grid;

20 providing n ordered axis declarations wherein n is at least 1, each said axis  
21 declaration names an axis comprising a first axis through a nth axis, wherein each said  
22 axis corresponds to a functional attribute of the design and has an axis size that

1 comprises two or more functional states of said functional attribute and has a  
2 corresponding axis variable;

3 providing one or more logic expressions that evaluate whether the design has  
4 achieved one or more of said functional states, said logic expressions set each one of  
5 said n axis variables to an integer value corresponding to said functional state when  
6 said logic expressions evaluate true;

7 providing a grid declaration that converts said n axis variables to a unique linear  
8 index value that corresponds to the cross-product of said functional states achieved by  
9 the design by multiplying the integer value of each said axis variable except the nth said  
10 axis variable by the product of the sizes of each higher-order axis than the axis to which  
11 said axis variable corresponds, summing the results, and adding the integer value of  
12 the nth said axis variable, said grid declaration also records a hit and maintains a map  
13 of hits at each linear index value determined during a simulation, and downloads said  
14 map to a database; and

15 providing a parser that translates said monitor declaration, said axis declarations,  
16 said logic expressions, and said grid declaration into a computer program comprising a  
17 higher-order software language, said parser further translates each said unique linear  
18 index value to a character string comprising a concatenation of character strings that  
19 correlate to said grid name and to each said functional state within said cross-product  
20 achieved by the design.

21 13. A method that monitors a design simulation using a grid to support design  
22 verification coverage analysis, comprising:



1 declaring a monitor in a monitor declaration that provides a unique name for the  
2 grid;

3 declaring n ordered axes using axis declarations, wherein n is at least 1, each  
4 said axis declaration names an axis comprising a first axis through a nth axis, wherein  
5 each said axis corresponds to a functional attribute of the design and has an axis size  
6 that comprises two or more functional states of said functional attribute and has a  
7 corresponding axis variable;

8 evaluating one or more logic expressions to determine whether the design has  
9 achieved one or more of said functional states;

10 setting each one of said n axis variables to an integer value corresponding to  
11 said functional state when said logic expressions evaluate true;

12 using a grid declaration that converts said n axis variables to a unique linear  
13 index value that corresponds to the cross-product of said functional states achieved by  
14 the design by multiplying the integer value of each said axis variable except the nth said  
15 axis variable by the product of the sizes of each higher-order axis than the axis to which  
16 said axis variable corresponds, summing the results, and adding the integer value of  
17 the nth said axis variable, said grid declaration also records a hit and maintains a map  
18 of hits at each linear index value determined during a simulation, and downloads said  
19 map to a database; and

20 translating said monitor declaration, said axis declarations, said logic  
21 expressions, and said grid declaration into a computer program comprising a higher-  
22 order software language, and translating each said unique linear index value to a  
23 character string comprising a concatenation of character strings that correlate to said

1 grid name and to each said functional state within said cross-product achieved by the  
2 design.

3 14. A program storage device readable by a machine, tangibly embodying a program  
4 of instructions executable by the machine to perform a method that monitors a design  
5 simulation using a grid to support design verification coverage analysis, comprising:

6 declaring a monitor in a monitor declaration that provides a unique name for the  
7 grid;

8 declaring n ordered axes using axis declarations, wherein n is at least 1, each  
9 said axis declaration names an axis comprising a first axis through a nth axis, wherein  
10 each said axis corresponds to a functional attribute of the design and has an axis size  
11 that comprises two or more functional states of said functional attribute and has a  
12 corresponding axis variable;

13 evaluating one or more logic expressions to determine whether the design has  
14 achieved one or more of said functional states;

15 setting each one of said n axis variables to an integer value corresponding to  
16 said functional state when said logic expressions evaluate true;

17 using a grid declaration that converts said n axis variables to a unique linear  
18 index value that corresponds to the cross-product of said functional states achieved by  
19 the design by multiplying the integer value of each said axis variable except the nth said  
20 axis variable by the product of the sizes of each higher-order axis than the axis to which  
21 said axis variable corresponds, summing the results, and adding the integer value of  
22 the nth said axis variable, said grid declaration also records a hit and maintains a map

1 of hits at each linear index value determined during a simulation, and downloads said  
2 map to a database; and  
3 translating said monitor declaration, said axis declarations, said logic  
4 expressions, and said grid declaration into a computer program comprising a higher-  
5 order software language, and translating each said unique linear index value to a  
6 character string comprising a concatenation of character strings that correlate to said  
7 grid name and to each said functional state within said cross-product achieved by the  
8 design.